

THE LATE TRANSIT OF VENUS.

On the whole the observations of the transit have been successful beyond expectation. Although in the United States there was more or less cloudiness, yet there were very few stations which did not succeed in accomplishing the most essential portions of their intended work.

The observations divide themselves broadly into two great classes; those—the most elaborately prepared for—which aim at data for determining the solar parallax*, and those which relate to the planet itself—observations spectroscopic, photometric, and micrometric.

The first class embraces observations of "the contacts;" measurements, (with the heliometer or other equivalent instrument,) of the distance of the planet from the sun's edge at intervals during the transit; and photography of the sun's disk with the planet upon it.

CONTACTS.—First, then, as to contact observations. Since Venus is much less than a third of the way from the earth to the sun when she passes between us, every one can see that the moment when she reaches the edge of the sun's disk it must vary with the observer's station, being earlier in some places than others. Now, the relations of things are such that if we could get absolutely accurate observations of these contacts at half a dozen widely separated stations, we could compute not only the slight deviations of the planet from its predicted position, but also its precise diameter, and the parallax and distance of the sun. The difficulty is in making the contact observations sufficiently precise; and in the present condition of optical art this difficulty lies mainly in the fact that the planet is surrounded with an atmosphere, which makes the edge indistinct, and renders it doubtful just where the planet's disk begins and ends. With any but excellent telescopes and eyes there are, moreover, other difficulties arising from what is called irradiation; but these can mainly be overcome by practice with an "artificial transit." This is an apparatus by means of which a fictitious planet is drawn by clock-work across a fictitious sun, the dimensions and distance of the apparatus being such that the appearance presented is as much as possible like the real event. The observer learns how the thing will look, and, after a little experience, comes to seize upon the true movement of contact with much greater accuracy and consistency than at first. But this apparatus does not reach the difficulty due to the planet's atmosphere, and no method yet proposed will do it.

On some accounts the first contact is the most difficult of observation, since usually the planet cannot be seen until after it has begun to encroach upon the sun. I say usually because when the sky is very clear and the telescope and observer both good, the planet's disk may sometimes be perceived before it touches the sun at all. In 1874 Janssen thus saw Venus, and in 1873 Langley saw Mercury under similar circumstances. Probably the ring of light produced by the refraction of the planet's atmosphere is aided by the background of the sun's corona to produce this effect. But such good fortune seldom comes, and, so far as we can learn, happened to none of the observers on Dec. 6. It has been common to regard this contact as having less value than the others, because of this difficulty of observation, but all the more recent experience of the later transits of Mercury and Venus goes to show that when proper care is taken to know the precise point on the sun's limb where the contact is to take place it is just as good as either of the others. It is, however, a little more likely to be lost, and on the day of the transit the weather was such as to enhance the difficulties, so that, in fact, it was not seen by more than half as many observers as the other three contacts.

According to the summary at the end of this article it was noted at 20 out of the 39 stations on this continent at which it might have been visible; and where there were several observers at the same station it was also generally missed by some of them.

At Princeton, the writer secured an unusually satisfactory observation, using the great telescope with its whole aperture of 23 inches. The polarizing eye-piece employed is of the Merz form, except that the first reflector is replaced with a hollow prism of metal with glass front and back, the cavity being filled with water. The magnifying power was 157. A minute or two before the predicted time the sun's disk came out distinctly through the veil of thin clouds which covered it. Vision was reasonably steady, and the faculae and granules of the solar surface could be well made out; but the field was full of scattered light, and not the slightest glimpse could be caught of the planet, though most earnestly looked for. The predicted time of first contact by the sidereal clock (allowing for its known error of 13s.) was 14h. 6m. 1s. The moment came and still no sign of the planet. Ten seconds passed, then 20s.; nothing yet. At 24s. I thought I perceived a little change in the appearance of the sun's limb at the precise point where Venus was to strike; each succeeding second strengthened the impression. At 30s. there could be no doubt that something was the matter, though there was yet no visible indication, only a sort of hardening of the outline. In a second or two more the notch caused by the advancing planet became evident; at 40s. it was obvious, and at 50s. conspicuous. It then extended along an arc of at least 30° of the planet's circumference, (its chord being about 15" or 20"), and I ceased looking. I set the contact as occurring at 14h. 06m. 50s. by the clock, which, reduced to Washington mean time, gives 5h. 55m. 40s. A. M. The number telegraphed to the papers was six seconds earlier, corresponding to the first glimpse obtained, but the effect then noted was probably due to the planet's advance upon the chromosphere of the sun. This chromosphere, though not bright enough to be seen distinctly, yet probably gives so much light that its obscuration can be noticed, felt rather than seen, by side glances, in the same way that stars, too faint to be visible by straight forward looking, can be caught by averted vision. I am confident that the time of the planet's contact with the outer limb cannot vary more than a second or two from the time stated. One other observer caught it at 6m. 38s., a third at 5m. 40s., and a fourth at 6m. 50s., but he distinctly saw that his observation was late. The rest of the Princeton observers did not perceive the planet for one reason or another until after 7m., when the notch already had considerable depth.

The difficulties presented by the internal contacts are of a different sort, but not really any less injurious to accuracy. At the late transit the sky so cleared up at most of our Eastern stations soon after the first contact that the ring of light surrounding the planet became visible—brightest (as it ought to be) just at the point most distant from the sun. As seen at Princeton with the great telescope—its aperture being now reduced by a cap to 6 inches—this delicate ring appeared to have a width of about 2', and was made up of little filaments standing out from the planet like short, fine hairs close together, with here and there a scintillant knot. We did not see, however, at Princeton the peculiar light on the

*The sun's parallax is equal to the semi-diameter of the earth as seen from the sun. When we say that the parallax is 8.5" it is the same as saying that, seen from the sun, the earth's diameter would be twice that, 17.0". Knowing this and the size of this earth, the sun's distance follows at once.

planet's disk noted by Prof. Langley at Pittsburgh about the same time.

As the time of contact approached, the sky at Princeton became nearly clear, and the definition was very fine and steady, so that the markings of the solar surface were beautifully distinct, and the halo of the planet's atmosphere was simply exquisite, arching over the dark globe as if the sun were reaching out delicate arms of light to embrace his daughter. At 14h. 26m. 50s. (by the sidereal clock) I judged that the disk of the sun would be just tangent to that of the planet if the atmosphere were out of the way; at 14h. 27m. the atmospheric halo still formed a slight, but perceptible, projection from the sun's limb; at 14h. 27m. 12.5s. it disappeared, leaving the limb quite smooth, and I marked this as the moment of contact, which agrees almost exactly with the mean of the times noted by the other Princeton observers. Observers at other stations where the air was favorable had similar experiences, though from the accounts which have appeared so far it would seem that Princeton was rather exceptionally favored in respect to the first and second contacts.

At the third contact the same phenomena should have been repeated in inverse order if the circumstances had remained the same. Probably this was seldom exactly the case. At Princeton, certainly, it was not so. The clouds were rather thick at the critical moment and the seeing a little unsteady, so that nothing was seen of the planet's atmosphere, and the time of contact noted was that when the thin line of light between the planet and the sun vanished; immediately after it the dark edge of the planet's disk began to project beyond the sun's outline. A few minutes after the third contact it cleared up somewhat, so that rudiments of the atmospheric halo were visible by glimpses, but there was no such revelation of the planet's outline as in the morning, nor was the seeing as steady, so that, as far as the writer, at least, is concerned, the observation of the last contact was hardly as satisfactory as the first.

From the summary it appears that at the 40 stations enumerated (on this continent) the first contact was observed at 20, the second at 29, the third at 32, and the fourth at 20.

So far as can be judged from a hasty and incomplete reduction of the observation at Princeton, it would appear that the planet was about 20s. to 25s. behind time in her orbit, and that her diameter assumed in the computations was at least 1', and perhaps 1.5", too large. The duration of the transit appears, also, to have been about 25s. longer than computed, which might indicate either of two things or a little of both—that the planet's path was 1' or 2' of arc north of its computed position, or that the diameter of the sun is a trifle larger than it was assumed. The agreement, however, is remarkably close.

HELIOMETER AND EQUIVALENT MEASUREMENTS.

The heliometer observations were made at only a few stations—by German parties at Hartford, Conn., and Aiken, S. C., and by Prof. Waldo, at Yale College.

The instrument consists essentially of a telescope, the object glass of which is divided into two parts, which can be made to slide past each other, thus: ~ The effect is to produce two images of anything looked at, and by properly setting the lenses the image of any object can be made to coincide with any other near it, and then the reading of a scale attached to the slides which carry the lenses will measure the angular distance between the objects. It is capable of measuring distances much greater than other forms of micrometer can deal with, such, for instance, as the diameter of the sun, whence the name of the instrument. The heliometers used by the German parties were rather small, having object glasses only 3 inches in diameter. The Yale heliometer, the only one owned in the country, is much larger, 6 inches in aperture, and probably the finest instrument of its class ever constructed.

During the transit the observers in charge of these heliometers measured just as rapidly as possible the distances between the two edges of the planet and the nearest and remotest points on the sun's limb, each complete "set" requiring at least 16 pointings and readings. The Hartford party obtained six full sets and four half-sets, besides a number of measures of the planet's diameter. At Aiken they only obtained three full "sets," with some diameter measures. It is not stated just how the results at New-Haven are to be divided. About 200 readings are reported, which might mean 16 full "sets," but probably does mean some smaller number of sets, plus a considerable number of measurements of the diameter of the sun and planet, since such measures are said to have been made.

At St. Augustine the French party did not use the heliometer, but had a double image micrometer of a different kind devised long ago by the distinguished astronomer, Arago, and depending for its action upon the double refraction of Iceland spar. They report themselves as completely successful, though the precise number of measurements is not given.

The Belgian party, at San Antonio, also made measurements of the distance between the planet and the sun's limb, but no statement appears as to the instrument employed. It may have been a heliometer, but probably was not.

Observations were also made at Cambridge and New-Haven by noting several hundred times the passage of the planet and the sun across a system of fine lines ruled on glass and placed in the focus of the telescope. It would not be at all strange if the results gotten by this simple method should be found to vie in accuracy with those obtained by more complicated forms of apparatus.

PHOTOGRAPHS.

The photographs were made in two different ways. The Government parties at Washington, Cedar Keys, San Antonio, and Fort Selden, and the Princeton and Lick Observatories used apparatus of precisely the same construction employed by the American parties in 1874.

The image of the sun is formed by a lens of 5 inches diameter and about 40 feet focal length. As it would be impracticable in the field to point so long an instrument directly toward the sun and keep it so pointed, it is placed horizontally in a north and south direction, and the sun's rays are directed through it by a flat mirror of unsilvered glass. The mirror, with its clock-work and the lens, is mounted on a pier just in the line of sight of a meridian instrument, and the frame for carrying the sensitive plate is erected on another pier inclosed in a separate light-tight building of its own—the photographic-house. The frame carries a so-called "reticle plate" of glass ruled with fine lines into centimetre squares, and also a plumb-line of fine wire which hangs between the reticle plate and the sensitive surface. Each picture, therefore, has upon it the image of the squares and of the plumb-line.

It is important to know exactly the distance from the lens to the sensitive surface, and a "measuring-rod" of iron pipe is therefore supported by a trestle-work just above the line of sight. A long tube projects from the photographic-house reaching nearly to the lens. The exposure is made by sliding a shutter carrying a slit, about seven inches high and an inch or so wide, across the opening in the side of the house where this tube joins on; and the

slide is electrically connected with the chronograph in the observatory, so that an automatic record is obtained of the moment of each exposure. The pictures of the sun are about 4½ inches in diameter, and the diameter of the image of Venus is just ⅓ of an inch. During the transit the exposures were made when the sun was clear at the rate ordinarily of one every minute and a half or two minutes, the intention being to secure about 200 pictures in the five hours between the two internal contacts. No attempt was made to determine the moment of contact by photography, experience having shown in 1874 that the results thus obtained have no value whatever.

During the operation one person attends to the direction and adjustment of the heliostat, so that the image may be properly kept upon the plate; while in the photographic-house three persons are employed—one who places the pictures in the reticle plate and manipulates the slide, one who hands up the sensitive plate from its box and puts it away after exposure, also keeping the record, and a third who is busy in developing the plates as fast as possible, taking perhaps one in every three or four, and so keeping the party informed as to the success of their operations and any needed changes in duration of exposure.

If all other conditions are favorable and proper care taken, the only anxious point in this method of photography relates to the flatness of the mirror. If its surface be curved to any perceptible extent the results will be fallacious; they may be consistent, but they will be untrue, and if the mirror changes its curvature during the operation they will be inconsistent as well as untrue.

The writer confesses to considerable misgivings as to this point, fearing the effect of the sun's rays, alternately clear and clouded, upon the mirror. A little experience the week before the eclipse was anything but reassuring. We had found the light of the reflected image less powerful than might be desired, requiring too long an exposure to suit us, and we concluded to try the effect of silvering the surface of the mirror. After silvering the mirror we found that the focus of the lens was apparently lengthened over two feet. This could be accounted for only in two ways—one was to suppose that the film of silver deposited was about 1-3000 of an inch thicker at the centre than at the edges of the mirror, thus giving it a convex form; the other, and far more probable, supposition was that since the film of silver now prevented the passage of the sun's rays into the body of the glass its front surface above became warmed by contact with the film, and thus the mirror was buckled into convexity. Of course, we at once removed the silver, but there remains a fear that even with an unsilvered mirror there may be notable changes of form under the influence of a changing radiation—changes perhaps sufficient to vitiate the results. Time only will show when the work comes to be reduced.

Except at Washington the photographic operations seem to have been unexpectedly successful, as the numbers given in the summary sufficiently show.

At Princeton a considerable number of the 188 were spoiled by clouds, perhaps 20 or 30, and a great many more are inferior to what they would be if the sky had been really clear. At Washington only about 53 were made. At Cedar Keys and San Antonio clouds also interfered to some extent, but at one place 150 and at the other 200 pictures were made. At Fort Selden and at the Lick Observatory the day was perfect, and the photography went on without a hitch.

At a few other places photographs of more or less value were made by other methods. At New-Haven about 150 pictures were taken with an 8-inch telescope, giving an image about 1 inch in diameter. Mr. Wilson, who operated the instrument, devised a very ingenious way, which has not yet been described, of getting a horizontal reference line on the plate by means of a level surface of mercury photographed upon it at the same moment with the sun's image. This would seem to dispose of one of the old difficulties of this method of photography, though it does not yet appear how the other (of scale value) will be dealt with. At Poughkeepsie 9 photographs were obtained by some method not explained, and at Providence 28. At St. Augustine the French party took over 200. Probably in both these cases the pictures were made in the same way as at New-Haven, though without the horizontal reference line. The French may, however, have employed the same apparatus they used in 1874, which closely resembles the American, but on a smaller scale, the focal length of the lens being only about 14 feet. In 1874 they also used the old daguerrotype process, on metal plates, instead of the collodion film on glass. The Americans in 1874 used the wet process; this year they employed dry plates, prepared a day or two before the transit by an emulsion process, preferring them to the ordinary dry plates of the market, because of the danger of injury to the latter in passing through tropical climates, as well as for other reasons.

MICROMETRIC OBSERVATIONS.

When Venus is upon the sun's disk we have an admirable opportunity of determining her diameter, because at that time she is nearest us; and moreover then, and then only, shows us her true form; at all other times she presents a phase like the moon. For this reason all the observers who were provided with suitable apparatus took great pains to measure her diameter as carefully and in as many different ways as possible—by observing the passage across wires or lines ruled on glass, by film micrometers, double image micrometers, and heliometers—all available instruments were pressed into the service. Observations of this kind seem to have been made at 15 or 16 stations on this continent, and perhaps at nearly as many more foreign stations. The results are not yet reduced, but the indications correspond with the conclusion which was drawn from the contacts—viz., that the planet's diameter is really considerably smaller than hitherto assumed.

THE ATMOSPHERE OF VENUS.

We have already mentioned the beautiful halo of light which surrounded and defined the disk of the planet between the first and second contacts. In connection with this should be noticed the remarkable observation of Prof. Langley, who, when the planet was about half entered upon the sun's disk, saw in this halo a bright point or patch of more brilliant light extending along some 20° or 30° of the planet's circumference, and apparently spreading inward over its disk. According to his observation it was not on the line joining the centres of Venus and the sun, but at least 20' south of that line. If it had been on that line there would have been nothing very surprising in it, because it is precisely that point of the planet's atmosphere most remote from the sun's disk which ought, by its refraction, to send us the most light from the sun's surface. In a clear sky, at the moment of external contact, the atmosphere at the point just about to touch the sun would send us no light at all, and the halo surrounding the planet should increase in width and brightness both ways from this place to its opposite maximum. It is perhaps not impossible that some local cloudiness on Venus shifted the point of maximum brightness enough to account for the observed asymmetry; or the phenomenon may be due to a very different cause. Several observers have already, at one time and another (see "Webb's Celestial Objects for Common Telescopes,"

"Chambers's Descriptive Astronomy," and other similar works) reported strange lights seen on the dark portion of the disk of Venus when she was crescent formed. Now, remembering what auroral and electric phenomena we are familiar with in our own atmosphere, it is not unlikely that on Venus similar phenomena should be presented on even a more extended scale, since she is nearer to the sun than we, and has, therefore, presumably an intenser meteorology as well as a denser air.

During the transit Prof. Harrington, at Ann Arbor, carefully examined the planet's disk and became fully satisfied that he could make out spots and markings on it. So far as we know, however, no one else has reported the same.

PHOTOMETRIC OBSERVATIONS.

At Cambridge a series of photometric comparisons was made between the disk of Venus and the sky just outside the sun's limb. The result was to show that Venus was distinctly darker than this part of the sky—as might have been (and was) anticipated, since, at the edge of the sun the illumination of our own atmosphere is reinforced by the light from the chromosphere and corona. One or two observers, at the time when Venus was half on the sun, received, much to their surprise, the contrary impression—that the disk of Venus inside her atmospheric halo was brighter than the background outside. Possibly this singular effect may have been simply subjective, or perhaps due to the fact that the whole circumference of the planet's disk was necessarily illuminated by a powerful twilight. To the writer, with the full aperture of the Princeton telescope, the disk of the planet seemed always, when the air was clear, intensely black, and darker than the background at the sun's limb. It was, perhaps, a little shaded at the edge, but otherwise he could detect no marking or difference of illumination of any kind.

SPECTROSCOPIC OBSERVATIONS.

So far as known to the writer, spectroscopic observations were made in this country only at Cambridge, South Hadley, Princeton, and Allegheny. For the most part the results were purely and surprisingly negative, no conspicuous evidence of selective absorption being shown by that portion of the planet's upper atmosphere which alone could transmit to us any light. We were a little more fortunate at Princeton, however, in finding distinct indications of water vapor, thus confirming certain old observations of Huggins. At the Harvard Observatory a diffraction spectroscopic was used first with a grating of 17,000 lines to the inch, and afterward with another one having about 5,700. The slit was placed nearly tangent to the planet's limb, at the point furthest from the sun's centre, since there the sunlight would have to traverse the greatest depth of the planetary atmosphere. With neither the highest or lowest dispersion could I detect the slightest effect upon the great "B" group—much to my surprise I own—nor in the "A" group either. But in the high dispersion spectrum the atmospheric water lines between and near the two Ds were distinctly and obviously, though not conspicuously, strengthened. I had intended to try a prismatic spectroscopic of low dispersion in the hopes of detecting in the spectrum diffuse bands which would be most easily seen with such an instrument, but when I finished with the diffraction spectroscopic the clouds had become so thick that there seemed to be very little chance of success. I therefore took off the spectroscopic and put on the micrometer, which was not much affected by the clouds so long as the planet's disk was visible at all. At the School of Science Observatory, Mr. McNeill, with a prismatic spectroscopic, (by Grubb,) attached to the 9½-inch equatorial, obtained results entirely accordant with my own. In addition he thought he detected a distinct effect of the planet's atmosphere upon the line at 6,302 of Angstrom's scale, and he suspected one or two other lines.

On Angstrom's map this line, No. 6,302, is ascribed to iron, which cannot very well be supposed to exist as vapor in the planet's air; but it is quite possible that the line is really composite, and that one of its components is due to some other substance than iron. The subject will, of course, be investigated.

FOREIGN OBSERVATIONS.

It is yet too early to know much about the success of the foreign observations. I have, however, added in the summary a statement of such reports as have come to hand. In Europe the weather was mostly bad, and nothing was got either at Greenwich or Paris. At the German Astrophysical Observatory, at Potsdam, the success was better, and we learn that numerous photographs were made, as well as spectroscopic observations. The most important stations, however, for combination with our own, are those in the southern hemisphere. We have already by telegraph most gratifying announcements of success from the Cape of Good Hope, from New-Zealand, Tasmania, and Australia, and especially from the parties at Santiago, Chili.

The most important parties yet to be heard from are those in the neighborhood of the Straits of Magellan. There are German, French, Brazilian, and American observers in that region, and the news from them will be awaited with great anxiety. Whatever it may be, however, enough is already secure to make it certain that we have observations sufficient in number and character to test the full value of the transit as a means of determining the solar parallax.

How long it will be before the observations (especially the photographs and heliometer measures) are fully reduced and published, it is impossible to say. It must be years at least. After this is done, it will be extremely desirable that some high authority, perhaps an international commission, should collect and discuss all the various observations both of this transit and that of 1874, and, from the enormous mass of material thus obtained, deduce the best final result which it can furnish, a result which cannot fail to be of the highest value in settling the dimensions of our universe.

C. A. YOUNG.

PRINCETON, N. J., Dec. 18.

SUMMARY OF STATIONS AT WHICH THE TRANSIT WAS MORE OR LESS SUCCESSFULLY OBSERVED, SO FAR AS HEARD FROM.

- The figures 1, 2, 3, 4 denote that the corresponding contacts were observed; P denotes that photographs were made on the same plan as those of the Government parties; F*, photographs on some different plan; A, heliometer measures; A*, measures for the same object as heliometer measures, but made with a different instrument more or less completely equivalent; S, spectroscopic observations; P, photometric observations; m, micrometer measures of the planet's diameter:
1. Ottawa, Canada—1, 2, 3, 4.
 2. Kingston, Canada—2, 3, 4.
 3. Cambridge, Mass.—1, 2, 3, 4, S, P, m; several observers.
 4. Providence, R. I.—2, F*, (23.)
 5. Amherst, Mass.—3, 4.
 6. South Hadley, Mass.—3, 4, A.
 7. Hartford, Conn.—2, 3, 4, A, m; German party.
 8. New-Haven, Conn.—1, 2, 3, 4, F*, (150.) A, m; several observers.
 9. Helderberg Mountain, N. Y.—1, 2.
 10. West Point, N. Y.—1, 2, 3, 4.
 11. Poughkeepsie, N. Y.—3, 4, F*, (9.)
 12. Brooklyn, N. Y.—1, 2, 3.
 13. Columbia College, New-York City—2, 3, 4.
 14. Western Union Building, New-York City—2, 3, 4.
 15. University City of New-York, New-York City—1, 2, 3, 4.
 16. Elizabeth, N. J.—2, 3, 4.
 17. Princeton, N. J.—1, 2, 3, 4, P, (182.) S, m; several observers.
 18. Philadelphia, Penn.—1, 2, 3, 4.
 19. Easton, Penn.—1, 2, 3, 4.
 20. Allegheny, Penn.—1, 2, (3) A, m.
 21. Pittsburgh, Penn.—2, 3.
 22. Wilmington, Del.—1, 2.
 23. Baltimore, Md.—2, 3, 4; several observers.
 24. Annapolis, Md.—2, 3, 4.
 25. Naval Observatory, Washington, D. C.—1, 2, 3, 4, P, (52.) m; several observers.
 26. Coast Survey, Washington, D. C.—2, 3, 4; several observers.
 27. Signal Service, Washington, D. C.—1, 2, 3, 4.
 28. Charlottesville, Va.—2, 3, 4.
 29. Alken, S. C.—3, 4, A, m; German party.
 30. St. Augustine, Fla.—1, 2, 3, 4, A*, F*, (200.) m; French party.
 31. Cedar Keys, Fla.—2, 3, 4, P, (180.) m. Government party.
 32. Chicago, Ill.—1, 2; several observers.
 33. Madison, Wis.—1, 2.
 34. Northfield, Minn.—3, m.
 35. Iowa City, Iowa—1, 2.
 36. Ann Arbor, Mich.—4, m.
 37. San Antonio, Texas—3, 4, P, (204.) m; Government party.
 38. San Antonio, Texas—3, 4, A*, m; Belgian party.
 39. Fort Selden, New-Mexico—1, 2, 3, 4, P, (216.) m; Government party.
 40. Lick Observatory, California—2, 4, P, (147.) m.

FOREIGN.

1. Potsdam, Prussia—1, 2, F*, S, m.
2. Jamaica—1, 2, 3, 4.
3. Puebla, Mexico—1, 2, 3, 4, A*;
4. Chapultepec, Mexico—No contacts; F*, (13.)
5. Cape Town, South Africa—1, 2, P; (?) American Government party.
6. Durban, South Africa—1, 2.
7. Tasmania—3, 4, P; (?) American Government party.
8. Melbourne, Australia—3, 4, F*, (23.)
9. New-Zealand—3, 4, P; (230) American Government party.
10. Santiago, Chili—Completely successful; P; (?) American Government party.
11. Santiago, Chili—Completely successful; A*, m; Belgian party.